PATENT SPECIFICATION (11) 1 484 256

1 484 256

(21) Application No. 54210/73 (22) Filed 22 Nov. 1973
(23) Complete Specification filed 14 Nov. 1974
(44) Complete Specification published 1 Sept. 1977
(51) INT. CL.[2] G11B 9/06
(52) Index at acceptance
G5R B11 B261 B263 B361 B36Y B60X B623 B650

(72) Inventors MICHAEL TREACHER TERRY
PHILIP BARNET VANDERLYN

(19)

(54) IMPROVEMENTS IN OR RELATING TO ARRANGEMENTS FOR SENSING RECORDED INFORMATION SIGNALS

(71) We EMI LIMITED, a British company of Blyth Road, Hayes, Middlesex do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

The present invention relates to signal sensing arrangements, and it relates more particulorly to such arrangements for sensing information represented by deformations recorded in the surface of a recording medium. Typically, though not necessarily, the medium may comprise a disc of plastics or other suitable material and the deformations may be recorded in sequence on a spiral trajectory in the record surface.

It is known that the recorded information may be sensed by means of a probe electrode which is held adjacent or in contact with the deformed surface of the record and a co-operating electrode, conveniently a flat plate electrode, at the other side of the record. When relative motion is introduced between the probe and the record surface, the deformations recorded in the surface cause a variation in the electrical capacitance between the probe and the co-operating electrode, and the sensing of such variations in capacitance permits the recorded information to be reproduced.

In order to store useful quantities of information in a record of convenient size, however, the dimensions of the deformations and of the probe must be very small, as must the separation between the probe and the record surface. For these reasons, the change in capacitance to be sensed is extremely small, and may amount, in a practical case to no more than a few tens of attofarads (1 attofarad $=10^{-18}$F). The capacitance to be sensed appears as an overall change in the total capacitance, mainly consisting of parasitic capacitances formed by adjacent electrostatic screening and capacitances associated with amplifying circuits. These parasitic capacitances usually amount to at least 10 picofarads, and difficulties arise in sensing a change of the order of one part in 10^5 or so, in a capacitance of this magnitude. In addition the parasitic capacitances will be subject to relatively large changes due to vibration and the motion of the record.

Various signal sensing arrangements (e.g. using f.m. techniques or the methods conventionally employed to amplify the signals from condenser microphones) have been proposed for overcoming or reducing the above difficulty, but for a variety of reasons these are not easy to implement.

It is an object of this invention to provide a signal sensing arrangement by means of which the above mentioned difficulty is overcome or reduced and which is simple to implement.

According to the invention there is provided a signal sensing arrangement for sensing information represented by deformations recorded in the surface of a recording medium comprising a probe electrode and a co-operating electrode for location on opposing sides of said medium and a bridge arrangement having an alternating current source and including a pair of closely coupled inductive ratio arms and arranged to sense changes in capacitance between the two electrodes.

The present invention thus involves the use of an inductive ratio arm bridge which may be of a type disclosed, in British Patents Nos. 581,161, 581,164 and 587,878 to which patents the reader is directed for a fuller explanation of the operation and construction of such bridges. Arrangements of this kind have the advantage that the parasitic capacitances can be separated from the desired signal capacitance in such a way that the former are substantially ineffective in altering the measured value of the signal

capacitance, their chief drawback being merely to reduce the sensitivity of the arrangement.

In order that the invention may be clearly understood and readily carried into effect, one embodiment thereof will now be described, by way of example only with reference to the drawing filed with the provisional specification, the single Figure of which shows, in diagrammatic form, an arrangement in accordance with one example of the invention.

Referring now to the drawing, a probe electrode 1 is held adjacent to a recording medium 5, the surface of which is deformed as at 5*a* to represent recorded information. A ground plane 4 is provided at the other side of the medium 5 to the probe. The lead 1*a* attached to the probe 1 has a screen 2 which forms part of an enclosure containing closely coupled inductive ratio arms 10. These ratio arms form part of a bridge network according to the aforementioned patents, of which the neutral point or bridge earth is connected to the screen 2. It will be seen that stray capacitances 6, which include those of the ratio arms, appear across the ratio arms, and in so far as the leakage impedance of the ratio arm windings can be made small, have a negligible effect on the bridge balance. An a.c. source 11 is connected between screen 2 and ground, so that a potential difference is maintained across the capacitance 9 to be sensed. Balancing means are provided in the form of a T-network comprising two fixed capacitors 12 and a variable capacitor 17 in conjunction with further ratio arms 13 connected across the a.c. source 11. This is not essential to the operation of the arrangement but permits balancing of the extremely small capacitance 9 to be carried out using conventional components. The variable capacitor 17 can conveniently comprise a varactor operated through a high resistance 18. Other suitable balancing arrangements could be used instead, if desired. The output from the bridge is derived from tappings embracing the whole or part of ratio arms 10 through a double-screened transformer 14, one of the screens being shown as an integral part of shield 2, in known fashion, and is applied to an amplifier 15 comprising a phase sensitive rectifier, the output from which is applied to resistor 18 to control the varactor 17 and therefore the bridge balance, by known means. Those skilled in the art will readily comprehend that similar means may be provided for balancing the quadrature or loss component of capacitance 9.

The wanted output, indicative of variations in magnitude of capacitance 9, may be derived in two ways. In the first it may be taken direct from the output of the phase sensitive rectifier of amplifier 15. For this purpose the bridge must be made to balance at a rate capable of following the highest modulation frequency in the recorded waveform, which may be difficult to implement stably.

Alternatively, the bridge may be made to balance at a rate which will accommodate relatively slow changes in capacitance 9, such as may be due to the scanning motion or other disturbances, the output from transformer 14 being taken additionally to a further amplifying and rectifying device 16 for processing the recorded information. The output at this point, as a result of the self-balancing means, should be indicative solely of rapid changes in capacitance 9, and not of its actual magnitude.

WHAT WE CLAIM IS:—

1. A signal sensing arrangement for sensing information represented by deformations recorded in the surface of a recording medium, comprising a probe electrode and a co-operating electrode for location on opposing sides of said medium and a bridge arrangement having an alternating current source and including a pair of closely coupled inductive ratio arms and arranged to sense changes in capacitance between the two electrodes.

2. A signal sensing arrangement according to Claim 1 including electrical means for balancing said bridge and comprising a T-network which includes first and second fixed-value capacitors and a variable capacitor, in conjunction with a second pair of inductive ratio arms connected across said alternating current source.

3. A signal sensing arrangement according to Claim 2 wherein said variable capacitor comprises a varactor.

4. A signal sensing arrangement according to any of the preceding claims including an amplifier having a phase sensitive rectifier, and a transformer arranged to couple output signals from said bridge arrangement to said amplifier.

5. A signal sensing arrangement according to Claim 4 including means for utilising output signals from said amplifier to balance the bridge arrangement.

6. A signal sensing arrangement substantially as herein described with reference to the drawing filed with the Provisional Specification.

A. B. LOGAN
Chartered Patent Agent

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed. 1977.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1 484 256
1 SHEET

PROVISIONAL SPECIFICATION

This drawing is a reproduction of the Original on a reduced scale.